CLAIMS

What is claimed is:

1. A method comprising:

   a) providing a metal-coated, porous substrate;

   b) exposing the substrate to a sample comprising one or more analytes;

   c) using laser excitation and spectroscopy to detect and/or identify one or more analytes.

2. The method of claim 1, wherein the substrate is a porous semiconductor substrate.

3. The method of claim 2, wherein the substrate is selected from the group consisting of nanocrystalline silicon, single crystal silicon, polycrystalline silicon, amorphous silicon and laser annealed silicon.

4. The method of claim 1, wherein metal nanoparticles are added to the metal-coated porous substrate.

5. The method of claim 1, wherein the spectroscopy is Raman spectroscopy.

6. The method of claim 5, wherein the Raman spectroscopy is surface enhanced Raman spectroscopy (SERS), surface enhanced resonance Raman spectroscopy (SERRS) hyper-Raman and/or coherent anti-Stokes Raman spectroscopy (CARS).

7. The method of claim 1, wherein the analyte is selected from the group consisting of an amino acid, peptide, polypeptide, protein, glycoprotein, lipoprotein, nucleoside, nucleotide, purine, pyrimidine, oligonucleotide, nucleic acid, sugar, carbohydrate, oligosaccharide, polysaccharide, fatty acid, lipid, hormone, metabolite, cytokine, chemokine, receptor, neurotransmitter, antigen, allergen, antibody, substrate, metabolite, cofactor, inhibitor, drug, pharmaceutical, nutrient, prion, toxin, poison, explosive, pesticide, chemical warfare agent, biohazardous agent, bacteria, virus, radioisotope, vitamin, heterocyclic aromatic compound, carcinogen, mutagen, narcotic, amphetamine, barbiturate, hallucinogen, waste product and contaminant.

8. The method of claim 7, wherein the analyte is a nucleoside, nucleotide, purine, pyrimidine, oligonucleotide, nucleic acid, amino acid, peptide, polypeptide or protein.

9. The method of claim 1, wherein the one or more analytes are labeled with one or more Raman labels.

10. The method of claim 9, wherein each analyte is labeled with a distinguishable Raman label.

11. The method of claim 1, wherein one or more capture molecules is attached to the metal-coated porous silicon substrate.

12. The method of claim 11, wherein the capture molecule is selected from the group consisting of oligonucleotides, nucleic acids, antibodies, antibody fragments, antigens, epitopes, lectins, proteins, polypeptides, peptides, receptor proteins, ligands, hormones, vitamins, metabolites, substrates, inhibitors, cofactors, pharmaceuticals, aptamers, cytokines and neurotransmitters.

13. The method of claim 8, further comprising detecting one or more nucleotides, purines or pyrimidines at the single molecule level.

14. The method of claim 13, wherein the nucleotide, purine or pyrimidine is selected from the group consisting of adenine, adenosine monophosphate, adenosine diphosphate adenosine triphosphate, deoxyadenosine monophosphate, deoxyadenosine diphosphate and deoxyadenosine triphosphate.

15. An apparatus comprising:

a) a metal-coated, nanocrystalline porous silicon substrate;

b) a laser; and

c) a Raman detector.

16. The apparatus of claim 15, wherein the porous silicon is used as a sacrificial layer.

17. The apparatus of claim 16, wherein the sacrificial layer is replaced by a metal.

18. The apparatus of claim 17, further comprising metal nanoparticles.

19. The apparatus of claim 15, further comprising a flow through cell operably coupled to the Raman detector.

20. The apparatus of claim 19, wherein flow passes through the metal-coated, nanocrystalline porous silicon substrate inside the flow through cell.

21. The apparatus of claim 15, wherein the metal-coated, porous silicon substrate comprises a uniform metal layer.

22. The apparatus of claim 21, wherein the metal layer is at least 3 microns in depth.

23. A wafer comprising a layer of metal-coated nanocrystalline porous silicon.

24. The wafer of claim 23, wherein the metal coating comprises silver, gold, platinum, copper and/or aluminum.

25. The wafer of claim 23, wherein the layer of metal-coated porous silicon comprises a plasma-oxidized, dip and decomposed (PODD) porous silicon substrate.

26. A method comprising:

a) providing a metal-coated, porous silicon substrate;

b) exposing the substrate to a sample comprising one or more analytes;

c) using laser excitation and Raman spectroscopy to detect and/or identify one or more analytes.

27. The method of claim 26, wherein the metal-coated, porous silicon substrate comprises a plasma-oxidized, dip and decomposed (PODD) porous silicon substrate.

28. The method of claim 26, wherein the one or more analytes are selected from the group consisting of a nucleoside, a nucleotide, a purine, a pyrimidine, an oligonucleotide, a nucleic acid, an amino acid, a peptide, a polypeptide and a protein.

29. The method of claim 28, further comprising detecting at least one purine, pyrimidine or nucleotide at the single molecule level.

30. The method of claim 29, wherein the single molecule is selected from the group consisting of adenine, adenosine monophosphate, adenosine diphosphate adenosine triphosphate, deoxyadenosine monophosphate, deoxyadenosine diphosphate and deoxyadenosine triphosphate.